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Can an Education and Counselling Program Improve Immunological Parameters in HIV Positive Patients on a Long Term?

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Abstract

Objective: Using an HIV-Care-Program, focusing on nutrition and lifestyle modifications through counselling, to improve immunological, clinical, anthropometrical parameters, and health status of HIV-infected patients over 30 months.

Methods: A cluster randomized trial, including 5 health facilities randomized to intervention n=100 (HIV-Care-Program) or control n=101 (usual care). The HIV-Care-Program consisted of an intensive Intervention for 6 months and follow-up for 24 months: The intervention consisted of counselling lessons on: nutrition, hygiene, coping with stigma and discrimination, embedded in practical activities. Outcome variables were CD4 count after 6, 12, 18, 24 and 30 months, and time to antiretroviral therapy (ARV) initiation. The analyses was carried out, using analysis of covariance, chi-square and Kaplan-Meier method respectively. The results of the follow-up period are presented.

Results: After 30 months, average CD4 counts dropped in the intervention group from 603.6 to 224 cell counts and from 555 to 112 cell counts in the control group, making a difference of 379 cells in the intervention versus 443 cells in the control group (P=0.044). Also, of the 201 who started the study without ARV, 30 (30 %) were initiated to ARV in the intervention group and 51 (50.5) % in the control group (p<0.001) after 30 months. Viral load decrease was observed in both groups. An association between early initiation to ARV and low viral load was observed (p=0.000).

Conclusion: The intervention provides a low-cost alternative improving health status, slowing down CD4 cell decline, and slowing down progression of HIV to AIDS. However, for better health outcomes, early initiation to ARV is required.

Keywords: HIV-Care-Program; Nutrition; Lifestyle; Counselling; Immunological Parameters

Introduction

HIV/AIDS remains one of the world's most challenging clinical and public health condition, especially in low- and middle-income countries, including Africa. Out of the 38 million people living with HIV worldwide, 70% come from su-Sahara alone. In Cameroon, HIV prevalence among adults (15-49) is estimated at 3.6%, with women and youths being the most vulnerable [1].

Significant research efforts are ongoing to reduce the burden of HIV infection on individual persons and populations: such as providing antiretroviral therapy (ART), or promoting supportive interventions such as nutrition optimization and lifestyle modification. ARTs as of now is one of the most effective and sustainable tools for HIV/AIDS management ARTs is capable of reducing the risk of HIV transmission, reducing the risk of tuberculosis infection among people living with HIV/AIDS by 65%, suppressing viral replication and improve CD4 counts [2, 3]. However, ART availability is still limited in sub-Sahara Africa settings and therapy is associated with side effects including changes in distribution of body fat, insulin resistance, fatigue etc., reducing the individual's adherence to treatment, thus leading to drug resistance [4-7].

Meanwhile, there is increasing agreement that nutrition plays a vital role in the care and management of HIV and is fundamentally linked to immune system functions. HIV infection impairs the individuals immune system, contributes to malnutrition due to a reduction in food intake, malabsorption and micronutrient deficiency resulting in further damages and disease progression to AIDS [8-12].

Previous and recent studies reveal that nutritional supplements have been proposed in several trials as an adequate strategy to improve clinical outcomes and to slow down the decline of CD4 cell counts in HIV infected patients [13-15]. However, these supplements are mostly expensive, interact with conventional medicines and beyond the reach of the majority of HIV infected patients in low income countries and accompanied by numerous side effects such as increased HIV transmission from mother to child [16-19].

Meanwhile, Cameroon has an abundance of nutritious and cheap locally available food, with a high potential of minerals, vitamins and antioxidants, which could contribute to improve the nutritional and immune status of HIV infected patients [20-22]. While in sub-Sahara Africa, knowledge on nutrition and HIV/AIDS is very limited, some evidence exist about the fact that lack of knowledge increases exposure to HIV and disease progression [23, 24].

Combining improved nutrition with healthy lifestyle practices such as moderate physical activity, avoiding alcohol abuse and smoking etc. to care and management of HIV infected persons is deemed vital, when considering HIV infection as a chronic disease [25-27]. In various studies it has been demonstrated that these factors have the potential to influence immune cells and the progression of the HIV disease [28-31]. Also, considering the fact that some HIV infected patients still don't have access to ART, coupled with the difficult side effect they have to deal with, it might be essential to associate nutritional management to ART treatment. Studies show that undernourished patients have 2-6 times higher chances of dying within the first 6 months of ART [32-35].

While each of these factors was investigated in isolation, but already showed positive effects on immunological parameters, it could be assumed that putting them together i.e. combining education and counseling, will have a stronger effect on a long-term, slowing down CD4 decline and retarding ARV initiation.

Therefore, we investigated the effect of regular participation in a nutrition and lifestyle modification program on HIV-infected patients in Yaoundé, Cameroon. This paper is the fourth publication presenting the 6 months intervention and 24 months follow-up results.

Method

Study population and recruitment

The intervention was conducted between June 2010 and December 2012 in Yaoundé; Cameroon. Considering the nature of the study, a cluster randomization by health facility was preferred, to minimize the risk of contamination through exchange of information between the intervention and the control group during routine visits.

Health facilities (HF) offering HIV care and/or treatment and a minimum of 100 HIV patients registered, were eligible for inclusion. The recruitment of study participant was conducted in the HF in 3 stages: 1). Identifying HIV infected patients aged between 20 and 72, CD4 >350 cells/ µl, viral load <100,000 cells/µl, and not receiving ARV 2) informing patient, on study aim, procedure and providing a chance to

ask questions. 3) Giving patients a possibility to return their written informed consent.

Ethical approval was obtained from the national ethics committee of Cameroon (Authorisation N°106/CNE/DNM/08), the Institutional Review Board of the Cameroon Baptist Health Unit (IRB2010-02), and the Ministry of Public Health in Cameroon (Division de la Recherche Operationnelle en Santé) (Authorisation Administrative de Recherche: N° 631-0211).

Intervention phase

Participants in the intervention group (HIV-Care Program) received:

Individual counselling: participant's nutritional status, nutritional need and nutritional knowledge were assessed using a 3-day dietary protocol, a food frequency questionnaire (FFQ) and self-administered questionnaires. Two sessions of individual counselling took place during the first 2 weeks of the intervention phase and counselling duration was 30 minutes for each participant. Subsequently, the intervention group was divided into 6 groups (16-20 participants per group) for group counselling. Altogether 22 sessions of group counselling was provided during the intervention phase.

Group counselling: group counselling included the following 4 topics:

HIV and Nutrition: effect of HIV on immune cells, effects of HIV on nutritional status, nutritional needs of HIV positive patients, composition of a balanced diet (emphasis was laid on the consumption of "5 a day" intake of fruits and vegetables, high intake of carbohydrate, high intake of protein of plant origin e.g. kidney beans, soy bean etc., high intake of dairy products and water, low intake of fat), "One dollar shopping" (aimed to help participant buy the right food even with less financial resources), malnutrition (causes of malnutrition, use of nutrition to reduce effects of malnutrition), nutrition and ARV (interaction between food and ARV) and food preservation (adequate methods for food preservation, consequences of poor food preservation methods on nutrient content) [36].

HIV and Hygiene: personal hygiene, food and water hygiene and hygiene of the home (kitchen, toilet, home) [37, 38].

Coping with stigma and discrimination: how to reconcile ones' situation with ones' self, reconciling with others, and reconciling with the society. Coping strategies included: (problem focused (e.g. joining a support group, getting counselling etc.) and emotion-focused (avoidance of problem, optimism, believing in God) [39-41].

Physical activity: moderate physical activity (PA). Moderate PA was defined as 25-30 minute walk per day, also equivalent to 2500-3000 steps in 30 minutes per day (i.e.100 steps / minute on level land) [42-43]. Lessons were accompanied by practical activities such as shopping tours in local market (participants were advised on when to go for food shopping, quality of good food e.g. fruits and vegetables), cookery seminars on regional food, and workshops on healthy lifestyle. Food for cookery seminars was provided by the study team.

Transport cost was refunded for participants who attended the counselling meetings. Group counselling took place once a week over six months and meeting duration was 3h per group. During this phase, facilitators were trained according to a standardized curriculum, to conduct the refresher sessions and support groups.

Participants in the control group were subjected to the general practitioner's choice of therapy (Usual-Care-Treatment Cameroon (UCT-Cam). In Cameroon, the usual care treatment for HIV/AIDS patients consists of periodic CD4 cell count and viral load check-up, and provision of family planning accessories and condoms.

Follow-up phase

The follow-up phases continued for 24 months. Participants in the intervention group received refresher sessions, lasting 3 hours every 2 weeks for 12 months (follow-up phase I), and subsequently 3 hours every month for 12 months (follow-up phase II). All refresher sessions were carried out by trained facilitators, assisted by the study dietician and coordinator.

Sample size considerations

With 6 health facilities , each recruiting an average of 60 patients each, the study would have 80% power to detect a difference between the two groups of 20%, with a between cluster variance of 0.005 [44,45]. A difference of 20% was chosen as an estimate of clinically relevant change. To yield an average of 60 patients per HF and a 10% drop out rate, a minimum of 100 patients per health facility were contacted. After 4 months of recruitment, instead of one month as previously planned, only about 100

participants were enrolled in each group, instead of 150 per group. For these reasons and others related to funding, the study management decided to begin the intervention with a sample sized of 100/101 study participant per group.

Randomization and masking of treatment allocation

Prior to study initiation, potential Health Facilities (HF) were assessed to determine size, number of HIV patient available, then randomly assigned to the intervention or control group, using a computer generated random list. This was done by an investigator not involved in the study, and stratification was done by HF size .The patient code was held only by the study coordinator and data bank manager during the trial. To preserve blinding, staff responsible for measuring and collecting health and socio-demographic outcomes, as well as clinicians involved in patient recruitment were unaware of group allocation.

Outcome measurements and data collection

Clinical and biochemical parameters: primary outcomes were change in CD4 cell count from baseline to 30 months, and time to ARV initiation. Secondary outcome was association between CD4 count at 6 months and viral load at baseline. CD4 cell count was measured using the flow cytometry (FacsCalibur [Becton Dickinson Immunocytometry system (BDIS), San Jose, CA, USA]). Plasma HIV viral load was measured with real time Abbot (Abbot Molecular Diagnostics, Wiesbaden, Germany), malondialdehyde (MDA) and albumin were measured using thiobarbituric acid (TBA) test and bromo-cresol green (BCG) colorimetric method respectively.

Nutritional assessment: dietary intake was assessed with a 3-day dietary record; including all food and beverages consumed, portion size and method of preparation. Nutrient intakes were analysed using a Nutrition Database, (**E**rnährungsanamnese-**B**eratungs-**I**nformations-**S**ystem EBIS version 2011 (University of Hohenheim, Stuttgart, Germany)). The complete dietary analysis contains 46 nutrients including carbohydrates, protein, fat, vitamin A, C, E, ß-carotene, zinc and iron. A food frequency questionnaire was used to assess the frequency of food intake, grouped in 9 major categories (meat, fish, vegetables, fruits, starchy food, dairy products, fats and oils, local dishes, miscellaneous).

Anthropometric measurements: height was measured to the nearest centimetre with a standiometer and weight to the nearest 0.1 kg with a standard scale (Seca 216 and 792, Hamburg, Germany).

Questionnaire: a self-administered questionnaire included demographic information (age, region of origin, educational level, occupation, marital status and socioeconomic status) as well as personal evaluation of program relevance.

Assessments of all parameters and collection of data were conducted at baseline, after 3, 6, 12, 18, 24, and 30 months in the intervention group, and at baseline, after 6, 18, and 30 months in the control group.

At the end of each weekly meeting in the intervention group, participants were asked to sign a register, including the number of meeting s attended.

Data analysis

Statistical analysis was carried out using SPSS statistics 20 (IBM Corporation, 2011). Baseline characteristics in both groups were compared using analysis of covariance (ANCOVA) and chi-square test. After 6 and 30 months, outcome variables in the two groups were compared using ANCOVA for continuous variables, and logistic regression for categorical variables, adjusting for clusters and baseline variables. The time to ARV initiation was calculated by using the Kaplan-Meier method, adjusting for clusters. Data that were not normally distributed were log transformed before analysis.

Finally, we also examined whether changes in CD4 cell count after 30 months was associated with baseline viral load, unadjusted using Pearson correlation, and then partial correlation, controlling for clusters. All analysis were conducted according to the intention-to-treat population and values were significant at $p<0.05$ without adjusting for multiple testing.

Results

Study population

The trial profile is shown in Figure 1. All five HF completed the trial. Of the 201 enrolled participants, 62 were evaluated for outcomes after 30 months, 41 in the intervention group and 21 in the control group respectively. The number of participants lost to follow-up was, 59% (intervention group) and 80% (control group) after 30 months correspondingly. The program was well

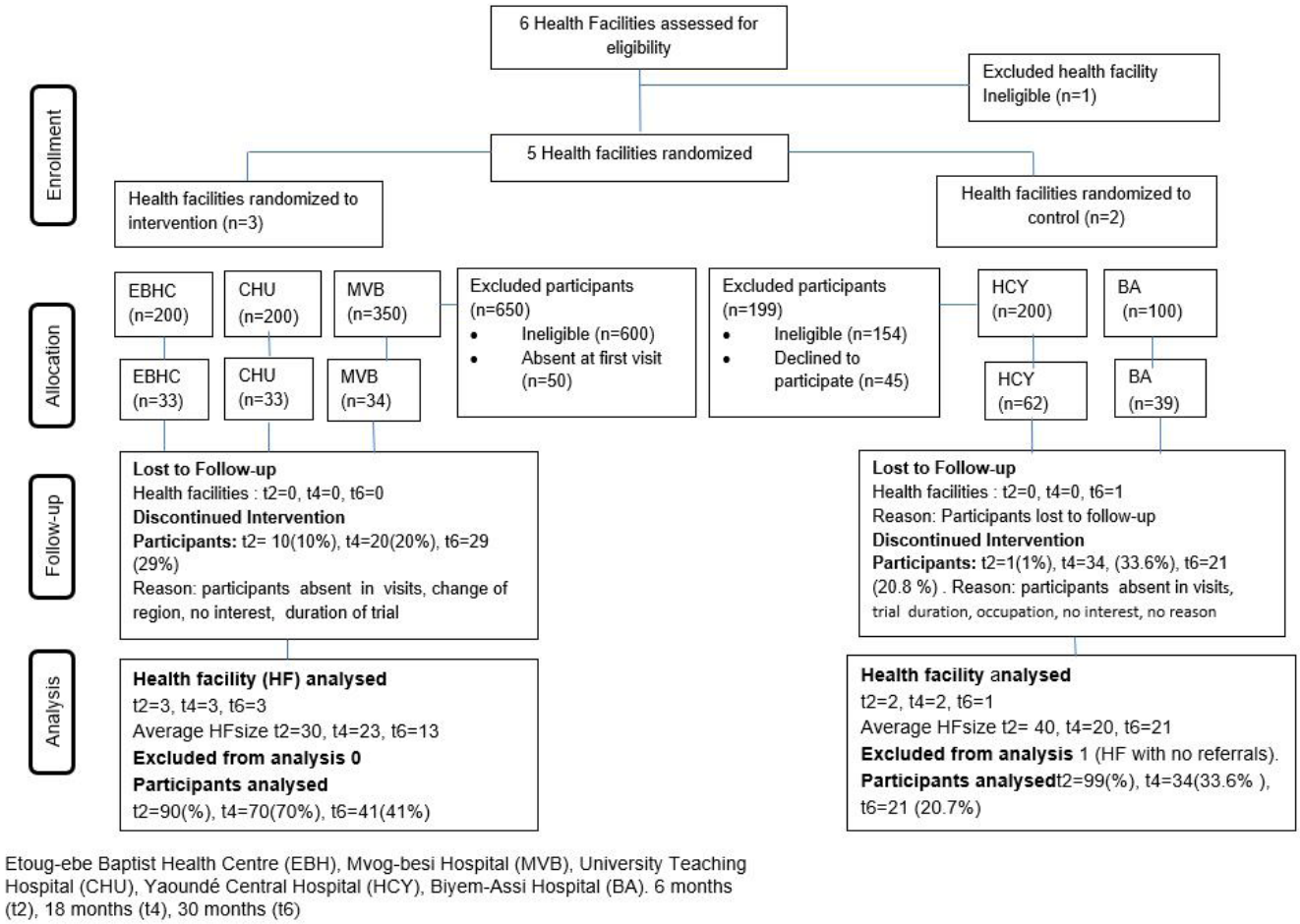

Figure 1: The flow diagram of clusters and individuals through the cluster randomized trial (30 months)

attended in the intervention group with more than 90% of the participants in the intervention group evaluating the program as being relevant and useful for their health.

Differences at baseline between the intervention and control group were not significantly different with respect to age, sex, marital status and years since HIV; weight, BMI, CD4 count and MDA (Table 1). Average weekly alcohol intake was 13 glasses of alcoholic beverages in the intervention group compared to 7 glasses in the control group. Macro -and micronutrient intake recorded from the dietary record at baseline was statistically different between both groups at baseline (Table 2). The highest level of education in both groups was secondary education and most patients belonged to the lowest socioeconomic strata with an average monthly income of 100.000 frs CFA (about 165 €).

Comparison of CD4 cell counts and viral load between intervention and control group after 30 months

The Figure below shows a significant difference in CD4 counts between the two groups over 30 months (T0 to T6). Average CD4 counts dropped in the intervention group from 603.6 to 224 cell counts and from 555 to 112 cell counts in the control group, making a difference of 379 cells in the intervention versus 443 cells in the control group. The drop in CD4 from To to T6 was significantly different (0.044).

Meanwhile Figure shows a decreased viral load in both groups after 30 months. In the intervention group, the viral load dropped from 32127 cells/ml at baseline to 28080 cells/ml after 30 months, compared to the control group with a decrease from 19244 at baseline to 9699 cells/ml after 30 months (p=0.049).

Number of patients on ARV after 30 months

After 30 months, 30 (30 %) participants of the intervention group and 51 (50.5) % in the control group (p<0.001) were initiated to ARV. No dead was registered over 30 months in the intervention group against 01 in the control group.

Effect of group, age, sex, group, on HIV status

Table 3 shows that a participant belonging to the

Characteristics	Intervention group (n=100)	Control group (n=101)
Health facilities randomized (n) %	3 (60)	2 (40)
Cluster size n (%)[6]		
[1]EBHC	33 (16.4)	0 (0)
[2]CHU	33 (16.4)	0 (0)
[3]MVB	34 (16.9)	0 (0)
[4]HCY	0 (0)	62 (30.8)
[5]BA	0 (0)	39 (19.4)
Demographic parameters		
Age (years) mean ± SD	33.0 ± 8.3	34.4 ± 10.0
Sex n (%)		
Male	31 (31.0)	35 (34.7)
Female	69 (69.0)	66 (65.3)
Region of origin n (%)		
Centre, South, East	32 (32.0)	54 (53.5)
South West, Littoral	10 (10.0)	10 (9.9)
West, North west	53 (53.0)	30 (29.7)
Adamaoua, North, Far North	5 (5.0)	7 (6.9
Marital status n (%)		
Married	38 (38.0)	42 (41.6)
Unmarried	58 (58.0)	50 (49.5)
No response	4 (4.0)	9 (8.9)
Education n (%)		
None	8 (8.0)	16 (15.8)
Primary	36 (36.0)	32 (31.7)
Secondary	37 (37.0)	38 (37.6)
University	19 (19.0)	14 (13.9)
No response	0	1 (1.0)
Employment n (%)		
Yes	37 (37.0)	29 (28.7)
no	59 (59.0)	69 (68.3)
No response	4 (4.0)	3 (3.0)
[6]Monthly income (frs CFA)	58 (58.0)	36 (35.6)
n (%)	13 (13.0)	5 (5.0)
< 100.000	5 (5.0)	3 (3.0)
100.000 - 200.000	24 (24.0)	57 (56.4)
> 200.000		
No response		
Clinical and anthropometrical parameters (mean ± SD)		
Weight (kg)	70.1 ± 13.0	69.7 ± 14.7
BMI (kg/m²)	26.1 ± 4.2	25.9 ± 5.0
CD4 (cells/µl)	603.8 ± 213.6	555.2 ± 198.2
Viral load (log)	4.5 ± 4.6	4.3 ± 4.4
Albumin (g/dl)	2.1 ± 1.0	3.4 ± 1.1
MDA (µmol/l)	3.3 ± 1.7	3.5 ± 2.7
Years since HIV disease was diagnosed	3.1 ± 2.1	3.7 ± 2.2

Table 1: Baseline characteristics of study participants: Clusters, Demographic, Anthropometric and Clinical parameters

Characteristics	Intervention group (n=100)	Control group (n=101)	RDA[1]
Nutrition (mean ± SD)			
Energy (Kcal)	2114.9 ± 496.9	2457.5 ± 966.1	2127.5[2]
Protein (g)	68.1 ± 22.2	84.8 ± 44.8	57.1
Fat (g)	81.7 ± 32.4	101.2 ± 49.9	65.6
Carbohydrate (g)	266.5 ± 70.8	288.8 ± 123.1	276.1
Vitamin A (µg)	1974.8 ± 1255.4	2907.1 ± 4381.3	800.0
ß-Carotene (mg)	10.6 ± 7.6	9.6 ± 5.6	8.0
Vitamin C(mg)	143.2 ± 100.2	159.8 ± 128.1	100.0
Vitamin E (mg)	11.8 ± 5.2	17.9 ± 14.1	12.0
Calcium (mg)	479.5 ± 253.5	482.2 ± 221.8	1000.0
Zinc (mg)	8.8 ± 3.2	9.9 ± 5.2	12.0
Iron (mg)	12.2 ± 4.0	14.2 ± 5.8	15.0
Alcohol intake n (%) Yes No No response	 41 (41) 53 (53) 6 (6)	 45 (44.6) 27 (26.7) 29 (28.7)	-
Smoked in the past n (%) Yes No No response	 9 (9) 79 (79) 12 (12)	 7 (6.9) 69 (68.3) 25 (24.8)	-
Physical activity in the past n (%) Yes No No response	 68 (68) 20 (20) 12 (12)	 61(60.4) 8 (7.9) 32 (31.7)	-

Table 2: Baseline Characteristics: Lifestyle

intervention group had a reduced risk (21 times) of being initiated to ARV (AOR=0.38 [0.21 – 0.68] p=0.001) compared to a patient in the control group. There was no association between age, sex, group and HIV status.

Effects of the CD4, viral load on the HIV status

Table 4 shows that irrespective of the group, an HIV positive patient at baseline with CD4 cell count below or equal to 500 (AOR=11.09 [5.62 – 21.91] p=0.000) had a higher risk (11 times) to be put on ARV compared to a patient with CD4 cell counts above 500 at baseline. At 30 months (T6), an HIV positive patient on ARV had higher chances (4 times) of having zero viral load compared to an HIV positive patient who was not on ARV (AOR=4.24 [2.02 – 8.90] p=0.000)

Compliance

Based on the average weekly meetings attendance in the intervention group and follow-up, compliance was good with about 60% participation at each meeting, over the 30 months intervention and follow-up period.

Discussion

The authors tested the hypothesis that an HIV-Care-Program, based on nutritional education and lifestyle modification would improve immunological parameters (CD4 cell count, viral load) in the intervention group compared to the control group after 30 months. In this study, a decrease in CD4 cell counts in both

		Coef.	AOR	IC95% [inf ; sup]		P
ARV	Intervention group	**-0.97**	**0.38**	**0.21**	**0.68**	**0.001****
	Control group	/	/	/	/	/
Dead	Intervention group	-19,17	4,71	4,71	482,71	0.41
	Control group	/	/	/	/	/
Neg	Intervention group	-1.14	0.12	0.08	1.35	5.05
	Control group	/	/	/	/	/
ARV	Female	-0.26	0.77	0.42	1.42	0.39
	Male	/	/	/	/	/
Dead	Female	-20.25	1.6	1.6	1.6	/
	Male	/	/	/	/	/
Neg	Female	-0.15	086	0.20	3.64	0.83
	Male	/	/	/	/	/
ARV	< 20 years	-14.94	0.99	0.001	3.25	0.58
	[20 – 30[	-0.21	0.59	0.81	0.39	1.71
	[30 – 40[	-	-	-	-	-
	40 and plus	/	/	/	/	/
Dead	< 20 years	-1.31	.	0.27	0.27	0.27
	[20 – 30[	13.65	0.99	0.000	8423,87	748.11
	[30 – 40[	-	-	-	-	-
	40 and plus	/	/	/	/	/
Neg	< 20 years	2.19	0.17	9.00	0.39	206.53
	[20 – 30[	0.34	0.76	1.40	0.16	12.09
	[30 – 40[	-	-	-	-	-
	40 and plus	/	/	/	/	/

Table 3: Effects of the sex, group and cluster on the HIV status

		Coef.	AOR	IC95% [inf ; sup]		P
ARV	CD4 ≤ 500 cells (T0)	**2.41**	**11.09**	**5.62**	**21.91**	**0.000*****
	CD4 > 500 cells (T0)	/	/	/	/	/
Dead	CD4 ≤ 500 cells (T0)	-17.78	1.91	1.91	1.91	-
	CD4 > 500 cells (T0)	/	/	/	/	/
Neg	CD4 ≤ 500 cells (T0)	-0.03	0.97	0.19	4.98	0.97
	CD4 > 500 cells (T0)	/	/	/	/	/
ARV	CD4 ≤ 500 cells (T6)	**1,55**	**4,71**	**1,72**	**12.87**	**0.003****
	CD4 > 500 cells (T6)	/	/	/	/	/
Dead	CD4 ≤ 500 cells (T6)	17.87	5749.79	5749.79	5749.79	-
	CD4 > 500 cells (T6)	/	/	/	/	/
Neg	CD4 ≤ 500 cells (T6)	17.87	5749.79	5749.79	5749.79	-
	CD4 > 500 cells (T6)	/	/	/	/	/
ARV	Viral load ≤ 1000 copy (T0)	-0.29	0.75	0.39	1.44	0.39
	Viral load > 1000 copy (T0)	/	/	/	/	/
Dead	Viral load ≤ 1000 copy (T0)	-18.45	9.675	9.675	9.675	-
	Viral load > 1000 copy (T0)	/	/	/	/	/
Neg	Viral load ≤ 1000 copy (T0)	**1.58**	**4.88**	**1.15**	**20.69**	**0.032***
	Viral load > 1000 copy (T0)	/	/	/	/	/

		Coef.	AOR	IC95% [inf ; sup]		P
ARV	Viral load ≤ 1000 copy (T6)	**1.44**	**4.24**	**2.02**	**8.90**	**0.000*****
	Viral load > 1000 copy (T6)	/	/	/	/	/
Dead	Viral load ≤ 1000 copy (T6)	18.02	672.6	672.60	672.60	-
	Viral load > 1000 copy (T6)	/	/	/	/	/
Neg	Viral load ≤ 1000 copy (T6)	18.02	672.6	672.60	672.60	0.99
	Viral load > 1000 copy (T6)	/	/	/	/	/

Table 4: Effects of the CD4, viral load on the HIV status

groups was observed, with a significant difference between the drops in CD4 count in the intervention group (379 cells) compared to the control group (443 cells) (p=0.044) over 30 months study period. Although CD4 counts did not increase as awaited, we however observed a slower drop in CD4 counts in the intervention group compared to the control group.

In the study, a significant decrease in viral load was observed between the intervention and the control group after 30 months. This decrease was stronger in the control group compared to the intervention group. Although average viral load of the intervention group was higher than that of the control group at baseline, it was not a significant difference. Thus, the viral decrease in the control group compared to the intervention group at 30 months could be explained by the fact that some patients in the control group while still participating in the study, could discretely be taking antiretroviral therapy as their CD4 count decreased. Also, the 06 patients diagnosed HIV negative in the control group after 30 months is an index that some patients after taking ARV had their viral load so low that a false positive could be detected. Table 4 shows a correlation between intake of ARV at baseline and almost zero viral load. Since we could not verify if a patient in the control group was taking ARV or not during the study, this remains a possible explanation for the low viral load at 30 months in the control group compared to the intervention group.

However, considering the fact that there was also a decrease in viral load in the intervention, it is intimating to assume that this could be a result of the intervention. Thus, considering the hypothesis that some patients in the control group could discretely have taken ARV, which improved viral load, it is alluring to think that If HIV positive patients are given ARV early enough, when CD4 is still high, associated with nutrition and lifestyle modification program, then there would be a more effective impact on CD4 and viral load, reduce opportunistic infections and better management of ARV side effects [46]. Previous and recent results confirm, the fact that an early initiation of ARV when patient has a high CD4 cell count, will reduce mortality in HIV positive asymptomatic patients and who have not received treatment before [47-50]. Unfortunately, it has been observed that most patients on ARV tend to neglect nutrition and practice unhealthy lifestyle, which could reduce life expectancy [51-53].

Previous and recent studies show increasing CD4 cell counts after nutritional supplementation in HIV infected patients [54-58]. So far, only a limited number of studies have been conducted in sub-Saharan Africa examining the diets based on local foods and lifestyle modification effects on HIV progression. These studies mostly report the effectiveness of local food in improving nutritional status of HIV patients [59-61].

It was assumed that the rate of decline of CD4 cells in the intervention group in our study might have been slowed down by the intervention. This assumption could be supported by the higher number of participants being initiated to ARV after 30 months in the control group (51), compared to the intervention group (30). Ghayomzadeh and co-workers observed an increase in CD4 counts after a lifestyle modification intervention of HIV infected patients [62]. Contrary to our study, it was just a short term intervention and the patients were receiving ARV. Another study using a low nutrient diet to evaluate CD4 counts, observed no effect on CD4 cell count and viral load in HIV asymptomatic patients [63]. In Kuria's study, a low nutrient diet with little variety was used and lifestyle was not addressed.

The absence of awaited increase in CD4 cell count could be linked to the relatively higher levels of average CD4 cell count observed at baseline, 603.6 cells/µl in the intervention group and 555.2 cells/µl control group respectively. Jiampton

and co-workers (2003) after administering micronutrient supplement observed the most pronounced positive effects in HIV patients with CD4 counts < 200 cells/µl [64]. Hong in a systematic review observed an increase in CD4 counts in HIV patients after macronutrient supplementation [65]. Contrary to our patients, Hong's patients were already taking ARV.

Rolina and Lindi also suggest that excessive supplementation of antioxidants could cause fluctuating CD4 cell concentration, meanwhile moderate doses could temporaly boost uninfected CD4 cell concentration, and slow disease progression. In our study, the intake of antioxidants was promoted through the "5 servings of fruit and vegetable a day"program [67]. Also, the intake of locally cultivated soybean, a rich source of antioxidant in form of Isoflavones aglycones was well encouraged [68, 69]. Analysis of the 3-day dietary record showed intakes of dietary antioxidants high above the required daily allowance (table 2). This could explain the decrease in CD4, although the quantity of antioxidant consumed through the local food was not directly measured.

Limitations: some limitations of our study should be taken into consideration. The trial design influenced the ability to detect significant changes. Cluster randomisation generally reduces the units available for allocation of trial groups. This trial originally included relatively small cluster of 6 health facilities, but due to the one year delay observed in starting the intervention, potential participants from one health facility where completely lost, since CD4 count decreased during this period to values below 350. Thus this health facility (HF) could no longer take part in the study. Also, the overall small number of HF is a result of the limited number of HF involved in the care and /or treatment of HIV/AIDS patients in Yaoundé. A larger trial would have allowed more precise estimation of the intervention and detection of smaller differences between groups. Further, during the period between study design and implementation, changes in the global recommendations for initiation of HIV patients to ARV were made, changing the criteria for ARV initiation from 250 cell/µl to 350 cells/µl, limiting the number of HF as well as patients fulfilling our study criteria [70].

The subjective approach (questionnaire) used to measure knowledge on nutrition and lifestyle was based on self-reporting. Therefore, participants' response on delicate topics may be inaccurate, reflecting what participant feel the investigator may wish to hear or think about them. In this case, recall bias could be introduced [71]. Finally, the fact that the study was not blinded also serves as a further limitation.

Conclusion: This study indicates that an intervention based on nutrition and lifestyle modification for ARV naïve HIV infected patients in a sub-Saharan low-/middle income country settings is possible and can slow down the rate of CD4 decline 30 months after intervention. Also, such an intervention coupled with early intake of ARV would go a long way to reduce viral load critically, reduce side effects of ARVs, reduce occurrence of opportunistic infections and improve health status. Thus, the need to make ARV accessible and affordable for all HIV infected patients in developing countries is strong.

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